

CLAIMS

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2 1. A microelectromechanical apparatus comprising:  
3 a base;  
4 a flap having a portion coupled to the base so that the  
5 flap is movable out of the plane of the base from a first  
6 angular orientation to a second angular orientation;  
7 wherein the base has an opening that receives the flap  
8 when the flap is in the second angular orientation, the  
9 opening having one or more sidewalls, wherein at least one  
10 of the sidewalls contacts a portion of the flap such that  
11 the flap assumes an orientation substantially parallel to  
12 that of the sidewall when the flap is in the second  
13 angular orientation; and  
14 a sidewall electrode disposed in one or more of the  
15 sidewalls.
- 1 2. The microelectromechanical apparatus of claim 1 wherein  
2 the flap further comprises a magnetically active element.
- 1 3. The microelectromechanical apparatus of claim 2 wherein  
2 the magnetically active element is a magnetic material.
- 1 4. The microelectromechanical apparatus of claim 2 wherein  
2 the magnetically active element is a coil.
- 1 5. The microelectromechanical apparatus of claim 2 further  
2 comprising an external magnet.
- 1 6. The apparatus of claim 1 wherein the flap is connected to  
2 the base by one or more flexures.
- 1 7. The apparatus of claim 7 wherein at least one flexure is  
2 electrically conductive.

1 8. The microelectromechanical apparatus of claim 1 further  
2 comprising a light-deflecting element disposed on the  
3 flap.

1 9. The microelectromechanical apparatus of claim 1, wherein  
2 the sidewall electrode is electrically isolated from the  
3 base.

1 10. The microelectromechanical apparatus of claim 1 further  
2 comprising:  
3 a voltage source coupled between the flap and the sidewall  
4 electrode to apply an electrostatic force between the  
5 sidewall electrode and the flap.

1 11. The apparatus of claim 10 wherein the flap contains a  
2 magnetically active material and the electrostatic force  
3 between the sidewall electrode and the flap is sufficient  
4 to prevent the flap from changing position in the presence  
5 of an applied magnetic field.

1 12. The apparatus of claim 1 further comprising:  
2 an electrode disposed on the base; and  
3 a voltage source coupled between the electrode in the base  
4 and the flap to apply an electrostatic force between the  
5 electrode in the base and the flap.

1 13. The apparatus of claims 1 where the base is made from a  
2 substrate portion of an SOI (silicon-on-insulator) wafer  
3 and the flap is defined from a device layer portion of the  
4 SOI wafer.

1 14. The apparatus of claim 1 wherein the one or more  
2 flexures include one or more torsional beams.

1 15. The apparatus of claim 1, further comprising one or  
2 more conductive landing pads disposed on an underside of  
3 the flap wherein the one or more conductive landing pads  
4 are electrically isolated from the flap.

1 16. The apparatus of claim 15, wherein one or more of the  
2 conductive landing pads are electrically coupled to a  
3 sidewall electrode.

1 17. The apparatus of claim 15 wherein one or more of the  
2 conductive landing pads is electrically coupled to the  
3 base.

1 18. The apparatus of claim 1 wherein the sidewall includes  
2 a sidewall electrode and one or more conductive landing  
3 pads that are electrically isolated from the sidewall  
4 electrode.

1 19. The apparatus of claim 18 wherein one or more of the  
2 landing pads are electrically coupled to the flap.

1 20. The apparatus of claim 18 wherein the sidewall  
2 electrode is electrically isolated from the base.

1 21. An array of one or more structures, wherein each structure  
2 comprises:  
3 a base;  
4 a flap having a portion coupled to the base so that the  
5 flap is movable out of the plane of the base from a first  
6 angular orientation to a second angular orientation, the  
7 flap containing a reflecting element;  
8 wherein the base has an opening with largely vertical  
9 sidewalls, at least one of the sidewalls containing an  
10 electrode, wherein the sidewalls contact a portion of the

11 flap such that the flap assumes an orientation  
12 substantially parallel to that of the sidewall when the  
13 flap is in the second angular orientation.

1 22. An array of claim 21 wherein one or more of the  
2 structures includes a sidewall electrode disposed in  
3 one or more of the sidewalls.

1 23. The array of claim 21, wherein the sidewall electrode  
2 is electrically isolated from the base.

1 24. An array of claim 21 wherein the array forms an optical  
2 switch.

1 25. An apparatus comprising:  
2 a flap that is movable from a first angular orientation to  
3 a second angular orientation; and  
4 a magnetic material disposed on the flap, the magnetic  
5 material having a stepped pattern.

1 26. A method for reducing stiction in a MEMS device having a  
2 flap that is movable with respect to a base, the method  
3 comprising:  
4 applying a fixed force to the flap to move the flap at  
5 least partially out of contact with an underlying base.  
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